

### OptiSwitch Master® - Policing IP/MPLS router

When building carrier based networks or an Enterprise core, the network specialist is confronted with a wide range of different techniques for network deployments. The various concepts being promoted by product vendors to build high density Multi-Gigabit equipment and overloaded features, are not, in many instances, suitable for providers edge areas and are overkill solutions for Enterprise core.

To better serve the actual needs of its partners, MRV has developed the OptiSwitch Master® (OSM) that addresses the aforementioned problems and provides flexibility and customization capabilities, that target carrier edge networks and Enterprise cores.

This document will define the OSM functionality and identify its benefits to be applicable in these specific conditions.

### OSM architecture

OptiSwitch Master® is a four, eight and sixteen slot chassis based on network processors that are optimized for Fast Ethernet or Gigabit Ethernet interchangeable modules (line cards).

The main function of network processors is to route and forward packets in wire-speed, providing full QoS support and packet filtering at the same time. The OSM is a full featured IP/MPLS router capable of performing look-ups and manipulations of every bit in the frame. The network processor instructions and routing tables are downloadable in runtime, meaning that the functionality can easily be changed at any given time, and the routing decisions making can change “on-the-fly” according to new configurations. Adding new features means simply downloading new firmware without changing the hardware. This is an essential characteristic for any organization that needs investment protection.

### Architecture benefits

- Wire-speed packet processing (L2/L3/L4).
- Packet classification and packet manipulation
- “On-the-fly” forwarding tables download (IP routes, MPLS flows, ACL flows)

### Network functionality

For typical carrier edge networks that need investment protection, OSM acts as a medium Gigabit IP/MPLS router with focused features as follows:

- IP routing full functionality
- Enhanced manageability of network traffic – CoS/QoS/Rate limit upon correlating ACLs
- VPN-MPLS circuiting via data layer or network layer
- Subscriber management
- Accounting
- Secure management

For typical Enterprise core that needs scalability and medium machine with industrial stability, OSM serves as core router with the following focused features:

- IP routing full functionality and complementary services (NAT , IPX , DVMRP , VRRP , IP Helper)
- Organization to ISP peering via BGP, and servicing as default Gateway
- Large routing tables capable of supporting wire speed forwarding information base
- Resources partitioning for various departments (Classification and Security)
- Secure management

## Medium Gigabit density for distributed model

The world of networking may undergo the same evolution that happened in the computing world, so that one should evaluate the potential of the distributed model advantages as opposed to “putting all the eggs in one basket”. Once we realize that a large Gigabit port density will not necessarily be a wise choice when establishing an edge carrier network, we draw the conclusion that preferring several networking machines that can balance and implement fail over operations, have a better fault-tolerant path towards stable, high available networks servicing thousands of subscribers.

## IP routing services

Today, the vast majority of carriers and enterprises have elected the standard IP protocol routing as the dominant protocol in their networks. The OSM design fully implements the industry standard IP protocol routing as its fundamental traffic facilitator, which is handled by a sophisticated open source Linux code. Linux routing code creates a tremendous IP routing suite, which is based on a unique, modular, multi-process architecture featuring control-plane components, that provide route redistribution and conversion, secure management services, and a network processor layer for routing and switching. This high-performance routing set includes OSPF, BGP, RIPv1v2 routing protocols, as well as distance vector IP Multicast via DVMRP and routing redundancy with VRRP.

OptiSwitch Master® is capable of identifying and storing large numbers of forwarding table entries. This is especially true in the core of an enterprise network or multipoint carrier infrastructures.

Layer 3 meshed networks based on OSM, create IP traffic flows that are forwarded over multiple routes.

Mesh routes are dynamically updated to reflect changes in the network topology, and if failure occurs for any reason in one of the OSM entities, traffic is automatically rerouted so that network resiliency is sustained.

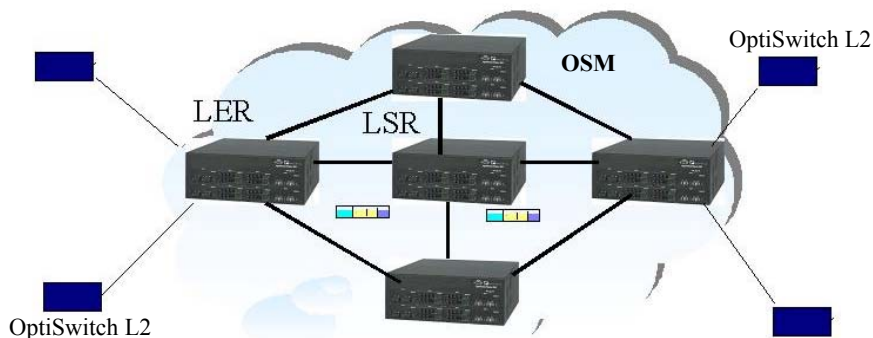
## VPN MPLS services

OptiSwitch Master® functionality, together with Multiprotocol Label Switching (MPLS), creates a significant benefit for VPN services in carrier or future innovative enterprise networks, by delivering QoS oriented connectivity with Ethernet, at a fraction of the usual ATM prices.

Delivering converged voice and data network results in massive cost savings when implementing OSM in a meshed backbone as an Ethernet circuiting engine. OSM’s MPLS implementation defines a way to group individual connections in a meshed data layer infrastructure. After configuring MPLS tunnels, Subnets/Subscribers can be bound to a tunnel edge and this tunnel can be implemented for the following applications:

1. An inter-branch communication defined as a point-to-point in large organization.
2. Assigning different ISPs to different subscribers over the same mesh infrastructure.

MPLS tunnels forward both Layer 2 and Layer 3 traffic via label path, when Layer 2 traffic is encapsulated according to the Martini draft. Label path configuration can be manual, or rely on LDP (Label Distribution Protocol) to distribute the necessary labels information among the internal OSM routers and carry the layer 2 packet through an MPLS cloud between two requested points. Layer 2 encapsulation through MPLS cloud enables an additional way of protecting an organization from Internet attacks and allowing a non IP traffic to traverse through routers mesh.



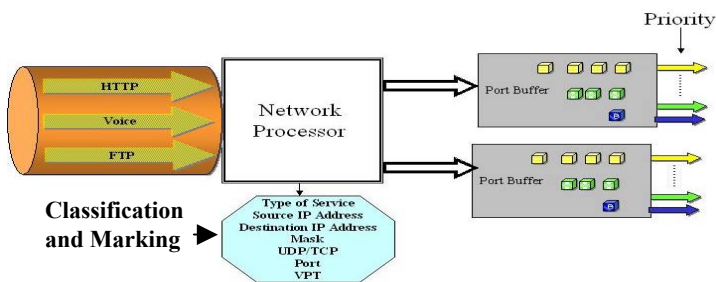
## The OptiSwitch Master® Classification solution

OSM incorporates Quality of Service (QoS) and advanced bandwidth management capability for the service provider and enterprise environments.

The ability to provide different levels of services across the network infrastructure is becoming an essential asset. Classification and policing allows for the establishment of traffic handling, based on the needs of specific types of applications and network subscribers. This is a powerful ability that assists in providing the service levels in carriers networks of today and the enterprise networks of tomorrow.

OptiSwitch Master® empowers this concept of like-circuit emulation, by analyzing all the streams that run over a carrier network and recognize a series of packet frames as belonging to a pre-defined circuit and bound to defined policy parameters.

Creating classifications allows carriers to enjoy revenue from services, which traditionally required circuit – technology, as well as from new services, which require Ethernet and IP switching technology.



The first phase in the process of flow classification is the matching of frames to flows. This can be done in a number of ways, according to the information in the frame's various headers, and according to other information such as the source port through which the frame entered. The second phase is to perform various actions and procedures based on a database of flow entries held internally within the Network Processor. These actions can include marking and re-marking of different fields in the different headers of the frame, checking conformity to the SLA, filtering and forwarding decisions, QoS decisions, statistics gathering, accounting, etc.

## Marking the frames

The marking is done in the VPT (Virtual Priority Tag) field of the VLAN header that is used for storing the class information and up to eight different classes can be represented. In the IP header, the TOS (Type of Service) field is used by DiffServ and up to 64 classes can be represented.

After marking the class information in the frame at the OSM edge, all the next nodes in the network can perform a simpler classification, using only the fields that carry the class information. Thus, the majority of nodes (interior nodes) in the network act upon marked fields and action rules to forward or drop packets.

Layer 4 parameters as per TCP and UDP headers include port numbers that only identify what application protocols are included with each packet. The end systems use this information to interpret the data contained within the packet and create awareness of applications type (HTTP,SMTP,FTP, Telnet etc.). OptiSwitch Master® is capable of classifying each application, differentiating between applications and enabling the prioritization of traffic based on specific applications. For instance, traffic for a mission-critical client/server ERP applications can be assigned different priority rules from HTTP Internet traffic, even if they both need to travel across the same OSM interfaces or network path built with multiple OSM's cloud. This crucial capability creates a powerful tool to enable the configuration of a network on an application basis.

## Queuing policies for congestion management

OptiSwitch Master® uses one of the three following queuing policies to service requests in the priority queues:

- Strict priority – ensures the higher priorities of throughput but at the expense of lower priorities (starvation). For example, during heavy loads, low-priority traffic can be dropped to preserve throughput of the higher priority traffic.
- Weighted Fair Queuing (WFQ) – distributes priority throughput based on weights specified as percentages. This policy is best for normal Internet and enterprise traffic models.
- Hybrid – distributes priority in combined SP and WFQ.

RED support – this is a feature that is typically found in core routers. Random Early Detection (RED) is a congestion avoidance feature that monitors network traffic load, and discards the packets at a stage sensed as a congestion threshold. The result of the drop is that the clients' side will detect the dropped traffic and will slow the transmission. The advantage of RED is in TCP oriented application services that require QoS levels (VoIP, Video on Demand etc.), but also in other transport services that can be marked with high priority.

## The OptiSwitch Master® accounting services

Traffic collection based on VLAN-Tag/PORT characteristics provides network managers with enhanced accounting of network usage, and support for traffic billing activated per Ingress/Egress of ports.

It can also gather statistics on the MPLS flows and count the total number of bytes that were received on a per flow basis. This enables the carrier to create complex billing schemes where services can be billed according to actual usage, and not according to 'flat rate' billing schemes.

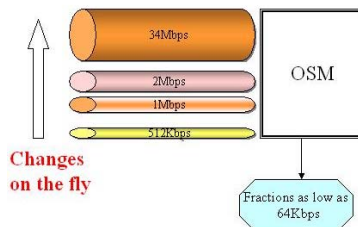
The billing collection scheme depends on the billing system implemented in the field that collects traffic counters and imports the results into a relational database for further processing in real-time or as refreshed pick-ups at defined intervals.

## Bandwidth management services

The provisioning of a packet circuit requires no manual re-configuration, unlike in the traditional circuit-switching world. Upgrading a 1.5/2 Mbps circuit (E1/T1) to a 45/34 Mbps connection (E3/T3) can be performed in the software, without any manual nor physical circuitry reconfiguration. This OptiSwitch-Master® feature, when compared to today's slow provisioning times that are measured in days or even weeks, represents a huge upgrade a carrier can provide to its subscribers by offering on the spot changes and self-provisioning capabilities. The OSM permits to rate limit the flows from a certain port and to correlate VLAN-Tag between 64 Kbps-1 Gbps in fractions of 64 Kbps. With this feature extended into the entire access network and backbone, service providers can see additional benefits, including better use of technician's time, and operational cost savings by preventing loss of revenue from inactivated services and the need to purchase costly new systems.

An additional consideration is the protection of your core; typically, you keep the backbone from being oversubscribed by limiting the amount of particular types of traffic from any ingress/egress ports.

Maximum bandwidth and minimum delay can be achieved by assigning the flow to the destination port's highest priority queue.



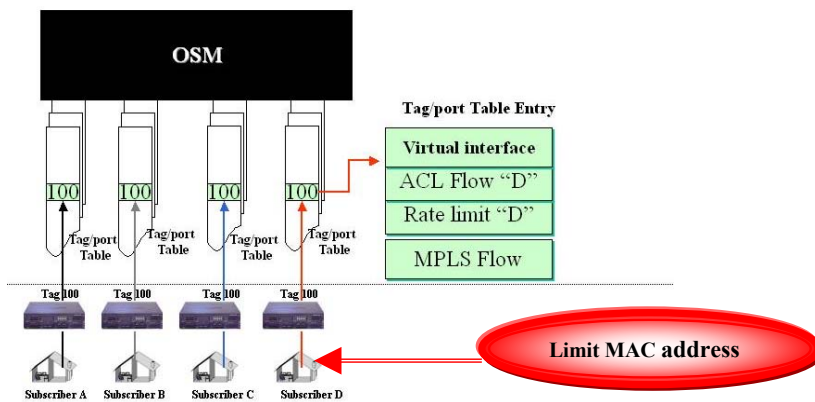
## Subscriber - Security intrusion control and ACL

An important feature of OSM is its ability to define isolated pipes for subscribers, which cannot be tapped or tempered with by neighboring users. OptiSwitch Master® can separate the traffic of individuals or multiple ISPs for security purposes.

This feature is critical especially in shared networks such as Carrier Class networks or Enterprise partitioning.

OSM creates subscriber management by creating a physical barrier between subscribers in the access network with termination of up to 4000 VLANs per port which represent users or network nodes, thus allowing up to hundred thousands of subscribers/nodes per single router.

Security partitioning means that directly sending data between subscribers is impossible, as all circuits are terminated in the OptiSwitch Master® router, which implements access list based security checks.



Reuse the 4K 802.1Q tag-Id range on each OptiSwitch Master® port for different customers, enables them their own Multi point transparent L2 network: each customer can have a unique 802.1Q Tag-Id identifier, the Tag-Id being any available Tag on the OSM relevant port. The subscriber mechanism makes sure that customers are separated from each other even if they have the same 802.1Q Tag-Id, or are located in the same subnet.

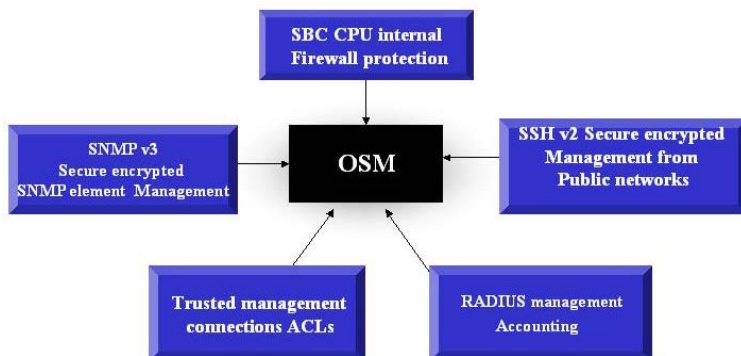
An access list flow can be attached to the subscriber/node, that verifies and filters all traffic it generates and receives. Extended action role can be in such a scenario that a subscriber/node can be hooked to a Martini L2VPN MPLS flow.

Each L2 subscriber can be limited to a predefined number of MAC addresses that it is allowed to learn.

Significant threat might be encountered if the number of entries in the learn table over-runs the Learn Table size. The forwarding can become affected up to a point of Denial of Service. In public, large scale L2 networks, the issue of Denial of Service caused by a few customers who bombard with random Source MAC addresses, is unacceptable. OSM enables a configuration where the number of L2 MAC addresses that one customer can generate is limited. OSM ensures that the service will not be affected in L2 networks by one or more customers, that may fill-up the Learn Table and create Denial Of Service.

## Secure management

OptiSwitch Master® positioning in carrier and enterprise networks requires a fundamental highly secure environment. OSM offers network management necessitates an easy to use set of tools simplify the management on one hand, while preserving a superior not compromised secure-stated environment on the other hand.



## Conclusion

The typical networking perception as to the necessity of having high-density core equipment in every network is weakened by the specific needs of edge carrier and core enterprise networks. MRV, as a leading networking solution designer, offers the OptiSwitch Master® as a state of the art IP/MPLS router, that includes core features with edge price to address the specific needs of network planners for enhanced QoS services in voice/data converged networks. Proven field installations world wide in major carrier networks and enterprises, consolidates its benefits for any mission critical implantation, as well as rapid tailored solution to any original requirement from customers.

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